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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CENTER RELATED RESEARCH GRANT

NGL-19-001-105

(E79-10291) INTERPRETATION OF REMOTE
SENSING DATA IN THE BAYOU LAFOURCHE DELTA OF
SOUTH LOUISIANA Final Report, 1 Jun. 1972 -
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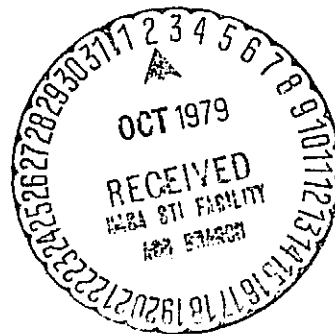
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CSCL 05B G3/43

FINAL REPORT

June 1, 1972 to August 15, 1979

Submitted September, 1979



Report Prepared By

C. A. Whitehurst
Principal Investigator

Division of Engineering Research
College of Engineering
LOUISIANA STATE UNIVERSITY
Baton Rouge, Louisiana 70803

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I. INTRODUCTION

The Division of Engineering Research, Louisiana State University, received a grant from National Aeronautics and Space Administration entitled "Interpretation of Remote Sensing Data in the Bayou LaFourche Delta of South Louisiana" (NGL-19-001-105). Work under this grant was initiated June 1, 1972, with initial efforts directed toward a comprehensive "ground truth" program and included the participation of several faculty and staff members from LSU and Nichols State University, graduate students at LSU, and undergraduate assistants from both universities.

The initial purpose of the program was to introduce and develop the use of space related technologies in the solution of regional problems. The region under consideration was, and remains to be, primarily So. Louisiana (Coastal Zone), with secondary interest in the rest of the state and region. The program followed two other NASA funded programs, the Sustaining University Program (SUP) and a Center related Program funded during 1971-1974. All of these programs, including 19-001-105 were step-funded.

The University administered the grant according to NASA policy and tried to support only those projects which contributed the most to the advancement and use of space related technology, more specifically remote sensing technology.

As the effort expanded, we concentrated on projects which were directly related to an identified program, state agency, or local group need. Presented in the attached matrix is a fairly comprehensive listing of these projects with a brief description of each. There was no real positive aspect of this program in the first two or three years with regard to cooperating agencies, actions and decisions and matching funds which were provided other than those provided by NASA. However, there is a bottom line. The State, through all of these efforts and by continual contacts with key persons, became convinced

that remote sensing was a viable technology. Project #19 of the matrix shows that there has been a major State expenditure; the program is now expanding exponentially. We have established a full-time remote sensing and image processing laboratory at LSU, funded by the state, and dedicated to research and the transfer of technology to the region at all levels.

We have developed concrete educational activities within the University (as well as outside) and are being recognized for these efforts. There are four courses in remote sensing currently offered on campus and the number of students enrolled per semester is approximately 120. Under development is a graduate course entitled "Environmental Applications of Satellite Remote Sensors."

A contract was signed with the Corps of Engineers to become the training and technology transfer center in remote sensing for all districts in the U.S. Two (2) 3-day workshops and two (2) 10-day workshops were taught in the last 12 months for the COE.

There are now the equivalent of six full-time professionals working in the area and several graduate students, approximately 12.

The Remote Sensing Center is now developing training courses for Coastal Zone Management and other State agencies. It is the intention of the Coastal Zone Management Commission at this time to make the Landsat Laboratory at LSU a line item in their budget for 1979 and thereafter.

These are fairly recent happenings, however, and a few words need to be said about the preceding years. As stated previously, the initial efforts were in "ground truth" studies of the region. At the end of the first eight months a program review was held and specific "Action Oriented Projects" (AOP) were defined. These projects were chosen based on the interest shown by state or local agencies, or local private interests. As these projects were completed, they were to be published as Research Monographs, and reviewed by NASA personnel as well as local authorities.

During 1973-74 the research team turned its attention to problems which are not as "action" oriented as previous ones but represented instead, a longer range view of economic development possibilities, and potential environmental management techniques in the delta region. The use of remotely sensed data constituted, in most cases, the basis for our studies.

Very brief descriptions of the results realized in the projects supported in this program are reported in the following section, and a list of the publications resulting from this work is given in the Appendix.

In the appendices are included such information as number and name of faculty, professional staff and students, a list of publications, and degrees awarded. This has been a most beneficial program. We feel that NASA, the University, and especially this College of Engineering, has realized considerable benefits from this grant.

GENERAL DISCUSSION

1. Administration Policy

This research grant was under the general direction of Professor Charles A. Whitehurst, who was the Principal Investigator. His responsibility was to encourage and coordinate research, and to channel funds necessary for supporting research and technology transfer efforts, and to act as liaison between LSU, NASA, and state and local agencies.

2. Research Projects Supported

A. 1972-74

The "Action Oriented Projects" (AOP) initiated in the spring of 1973 are briefly described as follows. The significant results from each project is noted.

a. Sugar Cane Gapping

We proposed to work with the Southdown Corporation of Houma, Louisiana in an effort directed toward the solution

of Sugar Cane "gapping". We initially proposed to:

- Determine the location and extent of gapping in cane fields of Southdown Corporation of Louisiana.
- Determine the cost of correcting this problem through "gap" planting.
- Compare the cost of "gap" planting in order to increase yield to the potential loss in revenue if the fields were left alone.

Due to camera failures, time lapse and other factors, this project had to be abandoned.

b. A Study of Sediment Transport and Erosion in the Fourchon Area of South Louisiana

The original purpose of the particular project was to define the biological, geological, and hydrological environments in the Bayou Lafourche area of South Louisiana and to relate the ground truth data to the data obtained from remote sensors, notably color infrared, I²S and RS-18 imagery.

It was learned that problems exist in the use of color infrared, I²S and RS-18 imagery in sedimentological studies of marshes since vegetational differences do not always reflect sediment differences and the marsh sediments are homogeneous and minute differences do not show on the photographs.

Spoil banks, canals, channels, beaches and marshes are easily defined from aerial photographs since each of these environments contain different soils and sediments.

Remotely sensed data can be used to explore for and map surficial or near surface sand bodies over wide areas.

The shoreline erosion rate was determined to be 75 to 100 ft/yr in some places. The areas undergoing erosion shift from time to time due to changes in wave refraction.

Erosion was also occurring at rapid rates in canals and channels, especially where strong currents enter the channel or on the outside of sharp bends. These areas are apparent from aerial data. .

Breaches in bay mouth bars may open and close from time to time greatly affecting local drainage near Bay Champagne.

Recommendations to the Louisiana Department of Public Works included:

- Engineering structures, such as groins, and retaining embankments should be placed on or behind beaches prior to any planned development. This may slow down or prevent excessive erosion.
- Aerial photographs should be used to check canals and channels for areas of excessive erosion. Such areas should be reinforced.
- A speed limit on motor craft may help reduce bank erosion along some channels and canals.
- Action should be taken to unblock tidal channels and other areas which affect tidal drainage.
- The barrier islands or bars across the mouth of bays should be preserved since they protect the marsh from waves and hence prevent erosion of the marsh.

c. The Use of Remote Sensors as an Aid in Marsh Management Practices

Such management includes (1) increasing the production

of resident species and (2) increasing the desirability of the marsh for migratory species.

These objectives can be attained through habitat improvement whereby food production is increased by creating a proper balance between marsh and associated bodies of water.

It was determined that there are problems in the use of color infrared imagery in sedimentological studies in the marsh areas of South Louisiana.

The infrared imagery may be very valuable in the study of sediments suspended in water, the direction of sediment transport and sediment traps by determining discharge patterns.

d. The Use of Color IR Imagery for a Vegetation Study of Spoil Banks in the Bayou Lafourche Region of South Louisiana

One of the most imposing problems in Louisiana, especially with the nation's recent increased demands for oil exploration and production, is the environmental impact of dredging and spoil disposal on the state's marsh and swamp lands.

This study dealt with the description of the vegetational change on the spoil banks in the Bayou Lafourche area through time (30 years) and space (banks in saline, brackish, and fresh water marshes, plus a fresh water swamp).

Color IR imagery was used to produce a vegetation map of the area, which extends from St. James Parish to the lower reaches of Bayou Lafourche. This map shows (1) fresh-water swamp, (2) fresh-water marsh, (3) brackish marsh, and (4) saline marsh and the locations of the spoil banks within these environments.

The results of this project were published as the Ph.D. dissertation of Miss Judith Monte, Geography Department.

e. Erosion and Sediment Transport in the Southwestern Canal (sometimes referred to as the Louisiana Canal), Lafourche Parish, Louisiana

The purpose of the study was to determine the capability of color infrared imagery to study the erosion of banks. The erosion rates were high and specific techniques and field and laboratory data were presented in a final report to NASA and in other publications which are noted in the Appendix.

B. 1974-75

In January 1975 certain tasks relative to the improvement of delta, or coastal zone, management techniques through the use of satellite remote sensors were undertaken. They were:

- The Possibilities for Farming Roseau Cane in the Louisiana Delta
- Highway Construction in a Marsh Region--Environmental Benefits Versus Environmental Cost
- Support of Office of Water Resources Technology (OWRT) Research Effort in Lake Des Allemands Region

In the first project we participated with the Earth Resources Laboratory, NSTL, Mississippi in a comprehensive program to accomplish the following:

- a. To define the extent of roseau cane growth in the Mississippi River Delta
- b. To define several major areas which could be used in an initial agricultural project.
- c. To determine optimum routes for transporting the harvested cane.

- d. To determine re-growth rates in different areas of the marsh.
- e. To define the relative significance of salinity in cane growth.

In the second project the effects of altering the sheet flow in a marsh region by constructing a highway was proposed with recommendations resulting from the study to be made to the Louisiana Department of Highways. This effort was dropped due to a total lack of support from the State.

The third project was accomplished in support of an OWRT project and in cooperation with the Louisiana Joint Legislative Council on Environmental Quality. The overall purpose was to study those water resource problems which may be attributed to the activities of the energy industry. This was accomplished by:

- a. Compile a data base (from existing sources when possible) for the study area to consist of the physical qualities of the area such as topography, hydrology, physiography, drainage, and distribution of soil classes and capabilities. Remote sensors were used to the extent possible.
- b. Mapping the distributions of pertinent land and water use factors in the form of overlays to a common base map to identify changes by decades, or shorter periods, and to facilitate the evaluation of energy industry alternatives.
- c. Determining the effects of these factors on the water quality and quantity of the lakes and estuaries.

A major report on this project was submitted to OWRT and NASA. Publications relative to certain environmental assessment methodologies are in preparation and will be appearing in the technical literature in the near future.

In addition to the above projects, an investigation of environmental factors associated with proposed jetty systems in Port Fouchon was completed. This work was done in cooperation with the Port Commission and a report submitted to that group. The results were also presented at a national conference and appear in the open literature, as noted in the Appendix.

C. 1975-76

1. Study of Impounded Areas - Backwater Swamps

Projects undertaken in this period included studies designed to: 1) justify the use of infrared aerial photography as a tool in the design of environmental management systems, i.e., the design and placement of engineering structures to be used in the relief of impoundment stress; 2) explore the quantity and quality of information derived solely from the imagery; and 3) recommend and define what ground truth data is required for an assessment of the causes and environmental impact of impoundment in the backswamp environment.

The aerial photographs used in this study were both high and low level color infrared and high level black and white infrared, as well as satellite data. The high level black and white and color IR photos were flown October 1974. This imagery, as well as the low level color IR photos which were flown October 1975, was supplied to the research team by NASA/ERL. Hurricane Carmen terminated efforts in certain areas.

2. Roseau Cane - A Possible Source of Energy in the Louisiana Delta

One aspect of this project was to map the distribution of Phragmites communis in the coastal marshes of Louisiana. This

study also encompassed the correlation of the morphological environment of Phragmites to the existing edaphic conditions and thereby supplementing our knowledge of environmental requirements necessary for optimum growth as preliminary information for possible agricultural potential in Louisiana. The ultimate goal was to determine the economic feasibility of establishing agri-energy farms in the delta, assuming environmental constraints are satisfied. NASA ERL completed a report in this general area related to single species identification from Landsat imagery. A M.S. thesis was also published at LSU.

3. In addition to these efforts, a LANDSAT-1 Photo Atlas of Louisiana was compiled as well as a project on general vegetation identification and mapping in Louisiana.

D. 1976-7

1. NASA-LOOP LANDSAT Groundtruth
(See 1977-78)
2. Lower Vacherie Impoundment Zone/NASA

The remote sensing and hydrographic studies of the Lower Vacherie Impoundment Zone were completed in May, 1977. The monitoring and mensuration of environmental change in the impounded swamp by various remote sensing media yielded information on the process of ecological succession and plant-vigor/water-supply relationships. The in-situ collection of physical water parameters helped in understanding why the impounded swamp is so markedly different from adjacent swamp areas. This information has been used to formulate recommendations made to the parish policy jury concerning breaches in the spoil-bank levee of Bayou Chevreuil to return the impoundment to normal swamp conditions.

The objectives of the study were to: 1) develop techniques for a remote sensing based monitoring system for environmental alteration in the swamp ecosystem; 2) measure the extent of environmental alteration in the impoundment and attempt to quantify this change using remote sensing media; and 3) determine what changes in the water regime have occurred and the relationship of those changes to the vegetation density and types.

Results of the study indicate that surface water flow from the impoundment becomes severely restricted when the water levels in Bayou Chevreuil falls below the range of 1.85 - 1.75 ft. MSL. The impounding conditions have led to deterioration of the swamp ecosystem in the study area. It was determined that this condition could be ameliorated to some degree by cutting the spoil bank on Bayou Chevreuil in several places. This would allow improved drainage from the saucer-like impounded area. Cuts should also be made through the spoil along the gas well access canal on the northern and northeastern boundaries of the impoundment. Cutting this spoil bank would enhance periodic flushing of the impounded area and help prevent stagnant conditions from developing. The optimum number and placement of the suggested cuts should be the subject of a more detailed study.

Results of this study were made available to local governing bodies and they have, in fact, corrected the problem noted by cutting the spoil banks.

3. Land Use Suitability Model

Land use suitability model of the Lake Boeuf, Lake Des Allemands (LBDA) area of Louisiana developed under an OWRT grant but with LANDSAT and aircraft imagery supplied by NASA has been transferred to the State of Louisiana computer facility for use

by interested state officials.

Suitability analysis is an assessment methodology which utilizes an analytical method for determining the environmental impact of activities (e.g., dredging, road building) on the various district land-use cells into which a geographic region can be divided. The cells can be uniquely identified by soil type, vegetation cover (obtainable from satellite imagery), soil chemistry, etc. The method utilizes matrix arithmetic and logical operations for a specified activity. Given an activity and cell, a number is calculated; the larger the number the more suitable (the less impact) a cell is for the activity.

The model developed in the LBDA was concerned primarily with energy related activities and uses four input matrices (see Figure 1) whose individual elements are determined by physical data as well as the judgment of experts in various fields (e.g., hydrology, agronomy) to produce the output ranking matrix. (Matrix 5 in Figure 1). The information contained in the output matrix can be used by planners and other state officials to minimize adverse environmental impacts in the LBDA region.

A complete list of the BASIC language programs required to implement the suitability model on the Honeywell Series 600/6000 computer system can be obtained from LSU.

E. 1977-78

1. NASA-LOOP LANDSAT Groundtruth

In October, 1976, personnel from NASA/ERL requested assistance from LSU to collect ground truth information for a LANDSAT derived computer classification of land use for the Louisiana Offshore Oil Port (LOOP) Project. Personnel from LSU's Division of Engineering Research (DER) made several trips to the

Port Fourchon area during the December/January and April/May time periods to survey the 26 ground truth sites selected by NASA. These field activities served as training exercises in remote sensing ground truth data collection for new DER personnel.

A combination of this field work took place during mid-summer and late autumn 1976 and was phased out in the 1977-78 reporting period.

2. Sensor Development and DCP Deployment

In the summer of 1977 a Data Collection Platform (DCP) was acquired from NASA (Slidell) to be deployed, initially (3-4 weeks), in the lakes bordering the LSU campus in Baton Rouge. While there, the platform will be used to:

- (a) train LSU personnel.
- (b) check out operation of the LSU provided sensor package with the DCP.
- (c) check out operation of the DCP including the satellite link.

One Phase (3-4 weeks) of this operation consisted of Operation of the DCP in water at sites located progressively nearer the coast, in the Barataria Bay estuary. There were three main objectives of this project, which was expected to continue for 18 months. They were:

- (1) gather data necessary to aid materially in locating sites for the placement (Fall, 1977) of four (4) DCP's for the LOOP-NASA project.
- (2) conduct an error analysis of the sensor package operating on the DCP in a changing environment (a master's thesis topic, completed in 1977).

- (3) conduct research on sensor/DCP operation in order to improve the time without maintenance for the data platform in the field.

This project was continued by LSU and is now a fully funded effort by the Environmental Protection Agency.

3. Shoreline Stabilization Using Remote Sensing Techniques for Data Collection

Louisiana's shoreline, like virtually every other shoreline, is a continually changing entity, affected by forces due to phenomena such as wind and water, and man's activity. Maintenance and protection of this important boundary between the Gulf of Mexico and the marshlands immediately inland--two related but critically different environments--is essential for a number of reasons. The shoreline and the delicate, critical gradient between marsh and Gulf that it helps maintain, is the key to the protection of important natural resources from destruction by natural erosion. Prevention of the inundation of terrestrial structures depends on shoreline stabilization and protection. The imminent increase in shipping activity, and related industry and commerce in the coastal areas necessitates stabilization of the shoreline. Also, the condition and location of the shoreline affects legal and social attitudes. In the past few decades various methods of shoreline stabilization have been implemented in Louisiana, with varying degrees of success. In 1977 a research project was initiated in an attempt to answer several questions in the area of shoreline maintenance.

The study was confined to a section of shoreline between Barataria Pass and Pass Fourchon, near Grand Isle, Louisiana.

Aerial photogrammetry techniques and LANDSAT imagery were used to provide data on the condition and activity of the shoreline areas.

LANDSAT imagery data was categorized for possible application to the shore protection problem. First, the feasibility of LANDSAT sensing as a viable method of collecting data pertinent to shoreline stabilization was determined. This included causative forces such as currents, waves, and storms, as well as their effects on the actual erosion of the shore. Data was then used (with aircraft data) to determine the optimum types and locations of stabilization structures. This project was completed in December 1978 and a Master's Degree thesis resulted from the work.

4. Landsat Computer System

In 1978 the State of Louisiana provided funds for a dedicated Landsat data processing facility. With assistance from this NASA grant, and others, a full-time remote sensing and image processing laboratory was established. Efforts under the NASA grant during this period were primarily in the technology transfer arena.

F. 1978-79

1. Landsat Computer System

Support for the LSU Center for Remote Sensing and Image Processing continued until August 15, 1979, the termination date of NGL 19-001-105.

The LSU Center for Remote Sensing and Image Processing is now committed to the continuing development of graduate and undergraduate research and educational programs in remote sensing and image analysis and in the transfer of technology to user groups. Research efforts conducted by the Center includes hardware and software developments, environmental modeling, image analysis,

sensor and instrumentation development and remote sensing applications. An interdisciplinary team of research scientists and engineers is presently working in the Center and have a wide variety of interests which are pertinent to remote sensing and image analysis. At present the research disciplines of special interest to Center personnel include: remote sensing, marine processes, atmospheric physics, environmental biology, environmental modeling, geology, geography, image processing algorithms, instrumentation, computer engineering, industrial image analysis, medical image analysis, and pattern recognition. Center personnel include:

Dr. Charles A. Whitehurst, Professor, Mechanical Engineering
Interests: Remote Sensing and In-Situ Water Quality Monitoring

Background: Environmental modeling, fluid flow, remote sensing applications in coastal areas, energy/environmental impact analysis, suitability analysis, sensor development.

Dr. Charles A. Harlow, Professor, Electrical Engineering
Interests: Image Analysis Algorithms, and Computer Engineering.

Background: Medical Image Processing, Image Segmentation, texture analysis, shape analysis and interactive software applied to radiographic images. Industrial image processing, automatic visual inspection techniques. Software testing and structure.

Dr. Oscar Huh, Associate Professor, Coastal Studies Institute
Interests: Remote Sensing and Coastal Processes, Remote sensing of environment. Atmospheric effects of remote measurement sensors.

Background: Remote sensing of coastal waters, studies of polar continental air and their impact on coastal waters. Use of satellite, aircraft and conventional oceanographic measurements to study sea surface temperatures.

Dr. John Hill, Assistant Professor, Division of Engineering Research

Interests: Remote Sensing and Environmental Biology.

Background: Remote sensing and water quality monitoring.

Dr. Joe Suhayda, Associate Professor, Civil Engineering

Interests: Coastal Processes; interaction of waves and winds, currents and coastal sediments; field experimentation and modeling.

Background: Study of shallow wave dynamics, mechanism of shelf sediment instability, shallow water environments and processes.

Dr. Larry Rouse, Assistant Professor, Coastal Studies Institute

Interests: Environmental remote sensing, atmospheric effects on radiation, coastal circulation processes.

Background: Atmospheric effects on thermal infrared radiation, analysis of DMSP, LANDSAT, NOAA satellite data, sun surface temperature measurements.

Dr. Ronald Malone, Assistant Professor, Civil Engineering

Interests: Environmental Modeling.

Background: Modeling of environmental quality in lakes and estuaries, field analysis, and data interpretations.

Dr. Richard W. Conners, Assistant Professor, Electrical Engineering

Interests: Image Analysis, Pattern Recognition.

Background: Texture analysis and interactive software applied to radiographic and CT images.

Dr. Simal Kahroom, Associate Professor, Geography

Interests: Remote sensing and applications to resource management.

Background: Microclimate studies in water sheds; modeling of hydrologic regimes, remote sensing of water sheds, lakes, coastal zones, vegetation mapping.

2. Remote Sensing and Image Analysis Laboratory

The Remote Sensing and Image Analysis Laboratory has comprehensive computer and image processing equipment for supporting research in remote sensing, image analysis and data processing. Besides modern equipment the laboratory has capable staff available with experience in digital system design, systems programming, as well as remote sensing and image analysis applications.

The Remote Sensing and Image Analysis Laboratory contains an Interdata 8/32 computer for use in image processing and remote sensing research. This machine has 256 K bytes of parity checked main memory,

two selector channels, high performance double precision floating point hardware and 1024 words of writeable control store. Further storage for this system is provided by a 67 megabyte disc and two 800 bpi 45 ips 9 tract magnetic tape units. Other standard peripherals include two CRT terminals, a 400 card/minute card reader and a modem for dial-up use.

The system software for the 8/32 computer includes the Dynamic OS/32 MT2 operating system, OS/32 MTM Multi-Terminal Monitor and HASP/32. Dynamic OS/32 MT supports a multiprogramming environment. It features dynamic memory management, roll in/roll out and program segmentation-reentrancy. When used in association with the Multi-Terminal Monitor (OS/32 MTM), it provides for a maximum of 16 concurrent on-line program development terminals, with a further capacity of 16 background batch jobs. HASP/32 is Interdata's HASP Multileaving Workstation Emulator task. HASP/32 permits the 8/32 to emulate the IBM HASP workstation. HASP/32 allows a user to transfer data between a device or file on the Interdata processor and a processor at the other end of a communications line. HASP/32 permits the use of both disc and tape for job I/O stream.

The languages implemented on the Interdata 8/32 include the CAL Macro Assembler and Interdata's FORTRAN VI. FORTRAN VI is a block optimizing language which is a superset of the ANSI Standard (X 3.9 - 1966).

The special purpose peripherals include a Comtal 8000-SE display, a Talos Series 648 Cybergraph digitizer and Varian Statos model 4222 printer/plotter. The Comtal 8000-SE display is a solid state refresh memory display with 512x512x8 bits resolution. The Comtal has some image processing capability built into the display

as well as a graphic overlay feature. The graphic overlay represents a bit plane of solid state memory. Data from this bit plane can be retrieved and overlaid on the digital image as the image is displayed. The Talos model 648 Cybergraph converts the physical position of a Pen or Cursor or an activated Digitizer Surface into a digital output. The activated surface on the model 648 is 48 x 36 inches. The Cybergraph system has a resolution of over 1000 points per inch. The Varian Stratos model 4222 printer/plotter is a high-speed raster scan device which prints information by sequentially scanning a linear array of styli along a fixed writing head and stepping the paper by an increment equal to the styli separation. These two operations, scanning and stepping are repeated as often as necessary to produce a matrix of dots which represents graphic data and alphanumeric characters. The model 4222 has a dot density of 200/inch and a paper width of 22 inches.

2. Technology Transfer

Technology Transfer efforts to date include workshops for the State Coastal Zone Management Division and the U.S. Army Corps of Engineers. Seminars and lectures have been given to the following groups.

SEMINARS AND DEMONSTRATIONS GIVEN IN 1978-79

EPA, Atlanta, Georgia - Coastal Remote sensing research efforts using Apalachicola Bay, Florida as an example area.

Agricultural Engineering - "Applications of Remote Sensing to Agriculture"

State of Florida/National Conservation Foundation - Presentation and Workshop on making Apalachicola Bay, Florida a National Estuarine Sanctuary

Mechanical Engineering - "Remote Sensing in Environmental Engineering"

Mechanical Engineering (Honor Society) - Applications of Remote Sensing in Environmental Engineering

Geography Department - "Satellites Monitor the Coastal Zone"

4th AWRA Conference and National Wetlands Symposium - "The Effect of Silviculture Activities on Estuarine Hydrology"

NASA, Goddard Space Flight Center - "Landsat Assessment of Silviculture and Dredging Activities in a Florida Estuary"

Academic Committee ("Coffee") - "Remote Sensing of the Environment"

Center for Wetland Resources - "The Possible Relationship of Satellite Data and Hydrodynamic Models"

Sunrise Club (Local Optimists) - "Remote Sensing and Ocean Research Aboard the R/V Calypso"

Civil Engineering Dept. - "Remote Sensing as Applied to Civil Engineering"

Civil Engineering - "Remote Monitoring of Air Pollution"

Plant Science Department - "Remote Detection and Assessment of Vegetation Damage"

State Geologist - Applications of Remote Sensing in Environmental Management

Coastal Zone Management Group - Applications of Remote Sensing in Environmental Management

State Forestry Division - Applications of Remote Sensing in Environmental Management

State Attorney General's Office - Applications of Remote Sensing in Environmental Management

Louisiana Soil Conservation Service - Applications of Remote Sensing in Environmental Management

SUMMARY

This entire program has been most beneficial to the Louisiana State University graduate program, especially in the College of Engineering. It has been instrumental in broadening the interests of the persons who participated and has been a key factor in developing the interdisciplinary interests of the University. The direct benefit to a particular NASA program may not be immediately realized; however, the benefits accrued to NASA, LSU, and the national interests over a period of time is more lasting, and in the long-term, more valuable.

Beyond the acquisition of a State supported Remote Sensing laboratory facility, it is difficult to absolutely measure some of the benefits derived from this program; we can determine a few of them. For example, the figures cited below represent a very definite and measurable benefit to LSU:

Number of universities participating	2
Number of faculty participants	12
Number of faculty receiving financial support.	8
Number of graduate students,	16
Number of undergraduate students	20+
Number of professional associates.	4
Number of Ph.D. candidates supported	2
Number of M.S. candidates supported.	14
Number of reports or papers published.	20
Number of reports or papers in preparation	2

It is clearly indicated by these figures that much has been accomplished with this grant. The multidisciplinary and interdisciplinary aspects of the total program are clearly shown in the number of faculty who participated and their disciplines. Most faculty members are aware of other disciplines and we are encouraged by willingness of the various departments to work together. This grant has, in a large measure, made this possible.

APPENDIX A

PERSONNEL SUPPORTED UNDER THE NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION CENTER RELATED RESEARCH PROGRAM

GRANT NUMBER NGL-19-001-105

June 1, 1972 to August 15, 1979

TABLE I

FACULTY PARTICIPANTS

NGL 19-001-105

<u>NAME</u>	<u>RANK</u>	<u>DEPARTMENT</u>
Bouvier, Maurice	Assoc. Prof.	Electrical Engineering
Brown, John	Research Assoc. (Nichols)	Marine Biology
Hill, John M.	Asst. Prof.	Engineering Research
Kinney, Ralph A.	Professor	Electrical Engineering
Modlin, David	Assoc. Prof.	Civil Engineering
Pruett, James	Assoc. Prof.	Industrial Engineering
Ragan, James	Asst. Prof. (Nichols)	Geology
Whitehurst, Charles A.	Professor	Mechanical Engineering

TABLE II

PROFESSIONAL STAFF PARTICIPANTS

NGL 19-001-105

<u>NAME</u>	<u>TITLE</u>	<u>DEPARTMENT</u>
Brignac, Kathy	Secretary	Engineering Research
Durbin, Warren T., Jr.	Research Assoc.	Engineering Research
Featherston, Billie S.	Secretary	Engineering Research
Kalcic, Maria	Research Assoc.	Engineering Research

TABLE III
STUDENT PARTICIPANTS

NGL 19-001-105

GRADUATE STUDENTS

Atam, Kemal
Blanchard, Tony
Breaux, Marlene
Doiron, Linda
Gasperez, Greg
Johnson, Thirl
Leuelling, Barbara
Milliet, Michael
Monte, Judith
Pado, Richard
Parker, Joseph
Roberts, Bruce
Sarco, William
Zeringue, Furcy

UNDERGRADUATE STUDENT EMPLOYEES

Blanchard, Anthony	Simms, Cary
Carver, Barbara	Swanson, Linda
Champange, Joy	Thibodeaux, Jerry
Clark, Laura	Whitehurst, Lee Ann
Cole, John	
Dantin, David	
Dantin, Keith	
Dantin, Mark	
Dunlap, Lee	
Erfurt, Douglas	
Evans, David	
Grogan, Patte	
Hoskins, Larry	
Kean, Clifton	
Kilgore, Fred	
Kinney, Alison	
LaFoe, Harry	
Lanoux, Paul	
LeBlanc, Mark	
Ogden, David	
Palmer, Charles	
Parker, Joseph	
Perry, Sally	
Seigler, Mark	

APPENDIX B

CAPITAL EQUIPMENT EXPENDITURES UNDER THE NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION CENTER RELATED RESEARCH PROGRAM

GRANT NUMBER NGL-19-001-105

June 1, 1972 to August 15, 1979

TABLE IV

CAPITAL EQUIPMENT EXPENDITURES

NGL 19-001-105

1974-75

Power Steering & Pump Assembly	\$186.52
Replacement parts for boat generator	49.90
Tecumseh compressor (cancelled)	93.47
Copeland compressor	91.10
Repairs on Mercury Motor on research vessel	263.37
Dry dock for boat	41.20
Fix leak in boat	488.54
Kodak Carousel Slide Projector	136.94

1975-76

20 HP Mercury Motor	469.37
OB Hull and OB Motor	320.00
Drawing Board	31.00

1976-77

Research Information Packages	100.00
Marine Battery Charger (cancelled)	35.93
Cable, Sony Model #DXC5000 Camera connecting cable to Color Sync Generator	180.00
Cable, Sync Generator to Video Tape Recorder	30.00
Motors	255.00
Water Level Recorder Stand (materials & labor)	193.75
Computer Compatible Tape	200.00
Remote deck Control Card	5.25
Remote Card for SP Caramate	7.50
Advance Card	3.75
Caramate record/playback & carrying case	453.09
COD Reactor	234.26

1977-78-79

Office Supplies	81.60
877 desk packs	854.90
Overhead Projector	315.18

APPENDIX C

PAPERS AND REPORTS PUBLISHED
PRESENTATIONS AND UNPUBLISHED PAPERS AND REPORTS
GRANT NUMBER NGL-19-001-105

June 1, 1972 to August 15, 1979

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- Whitehurst, C. A., with B. Sarco and W. A. Blanchard, "Wind Energy Potential in the Coastal Areas of Louisiana", Louisiana Engineer, December, 1976, pp. 6-9.
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- Whitehurst, C. A., "A Parametric Study of Water Resource Variables in a Delta Region of South Louisiana," with Drs. E. J. Dantin, J. Green, R. Kinney, J. Ragan, and Mr. Kazmann, OWRT Grant 14-31-001-9018, March, 1974.
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Blanchard, W. A., Image Enhancement and Mensuration of Post-Camille Photography Using Equipment at the EROS Applications Assistance Facility, NSTL. Joint Legislative Committee on Environmental Quality, State of Louisiana, Baton Rouge, 1975, with A. J. Lewis, B. S. Small, and J. Breeden.

Blanchard, W. A., "The Ten Natural Vegetation Regions of Louisiana: An Interpretation Utilizing Imagery from the Earth Resources Technology Satellite," NASA, 1975.

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